Idaho State Department of Agriculture
Division of Agricultural Resources

Lake Cascade Tributaries
Water Quality Monitoring Report
April 2007 through October 2007

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Introduction

The Idaho State Department of Agriculture (ISDA) in cooperation with the Idaho Department of Environmental Quality (IDEQ) conducted a water quality evaluation of six tributaries that discharge into Lake Cascade. Lake Cascade watershed is located in west central Idaho and encompasses over 357,000 acres of land. The six tributaries are within hydrological unit code (HUC) 17050123 and are located in Valley County. The six tributaries evaluated (Figure 1); North Fork Payette (NF-1), Lake Fork (LF-1), Mud Creek (MC-1), Boulder Creek (BC-1), Willow Creek (WC-1), and Gold Fork (GF-1) all discharge into Lake Cascade and were evaluated as part of the original Cascade Reservoir total maximum daily load (TMDL). The primary goal of the Cascade Reservoir TMDL was to limit inputs of total phosphorus (TP) into the reservoir to limit excessive algae concerns, lower chlorophyll *a* levels and improve clarity and overall water quality. The phased TMDL process was implemented in 1994 and established in-reservoir targets of ≤0.025 mg/L for TP and <10 µg/L for chlorophyll *a*.

The data collected by ISDA in 2007 is compared to data collected by IDEQ during the 1999 and 2000 season. This data comparison will attempt to discern if there has been any improvements in water quality since the 1999 to 2000 period and 2007.

A problem with this comparison is that the two data sets do not represent the same temporal and spatial periods. ISDA collected bi-weekly samples from April 5 through October 31, 2007 (n=15) while IDEQ collected data on a monthly basis from October 1999 to September 2000 (n=12). ISDA's sampling time frame was established to cover snowmelt activities and to encompass the agricultural irrigation season. IDEQ data covered the same period but included winter data (December thru February) when environmental conditions usually don't have a major impact on water quality.

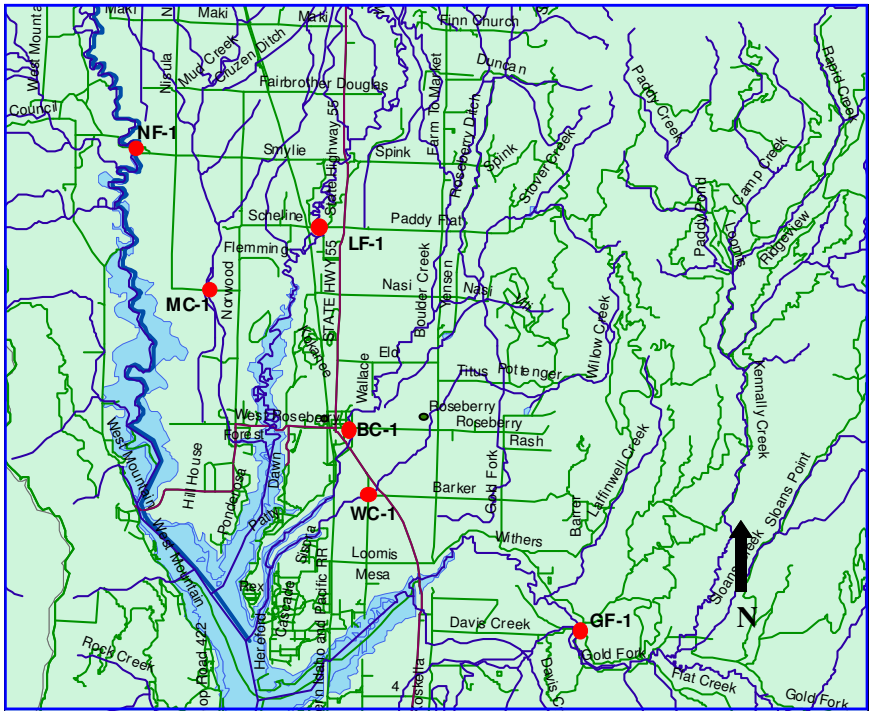

Figure 1. Cascade Lake tributary monitoring sites.

Parameters collected by ISDA, during this study, were suspended sediment concentration (SSC), total phosphorus (TP), ortho phosphorus (OP), Escherichia Coli (*e-coli*), dissolved oxygen (DO), temperature, conductivity, total dissolved solids, pH, and discharge.

Results

Suspended Sediment Concentration (SSC)

Sediment was considered a pollutant of concern for the TMDL development for Lake Cascade. ISDA was unable to locate any SSC data from previous work conducted by IDEQ for comparison. SSC data collected by ISDA are very low in concentration (Table 1) and would be rated excellent for high quality fish habitat (Table 2).

Table 1. SSC statistics (mg/L)

Site	Mean	Median	St. Dev	High Value	Low Value
NF-1	2.23	1.75	1.68	7.4	0.7
MC-1	2.71	2.7	1.55	5.6	0.6
LF-1	1.74	1.3	1.26	5.1	0.6
BC-1	2.1	1.7	1.2	4.9	0.8
WC-1	2.35	1.7	1.93	8.5	0.7
GF-1	1.73	1.3	1.83	7.7	0.5

Table 2. Suspended sediment and fisheries effects.

Suspended Sediment Concentration (SSC)	Possible Effects on Fisheries
<25 mg/L	No evidence of harmful effects on fish.
25-80 mg/L	Possible to maintain good to moderate fisheries however yield would be somewhat diminished relative to water with <25 mg/L.
80-400 mg/L	Unlikely to support good freshwater fisheries.
>400 mg/L	At best only poor fisheries are likely to be found.

DFO, 2000

The majority of the sediment observed at all stations consisted primarily of sand and appeared to move as bedload and not suspended within the water column. The substrate at all of the sites became mostly armored with sand as the season went along and discharge rates slowed. This heavy armoring causes the loss of quality macroinvertebrates that are needed for food to support a healthy fish population.

Total Phosphorus (TP)

The TMDL developed for Cascade Reservoir in 1994 had an in-reservoir goal for total phosphorus of ≤0.025 mg/L. Specific phosphorus goals for the tributaries have not been established but using the 0.025 mg/L should indicate how close these tributaries are to meeting their TP loading goals. The data collected by DEQ in 1999 and 2000 compared very well with the data collected by ISDA in 2007 (Figure 2). The 2007 data indicate three sites on average are below the reservoir goal of ≤ 0.025 mg/L. The North Fork (0.01 mg/L), Lake Fork (0.016 mg/L), and Gold Fork (0.019 mg/L) were on average below the TMDL TP goal for the reservoir.

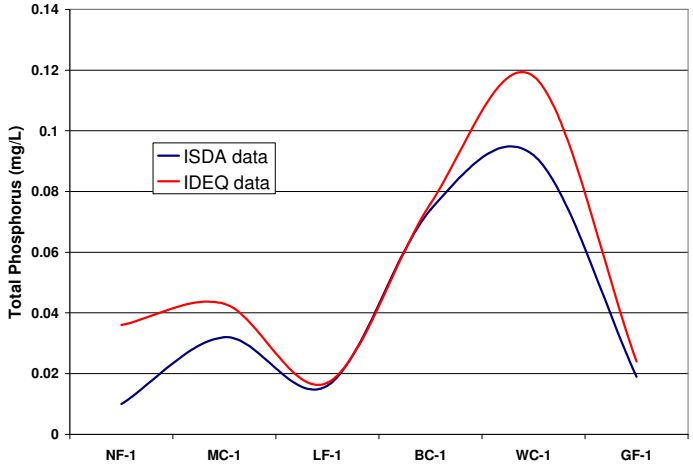

Figure 2. Average TP comparison ISDA (2007 and IDEQ 1999 & 2000).

Five out of six stations showed no significant difference from the 2007 data when compared to the 1999-2000 data for phosphorus. Only the North Fork site (NF-1) showed a statistical significant difference ($p<0.05$) in the average level of phosphorus (Figure 3).

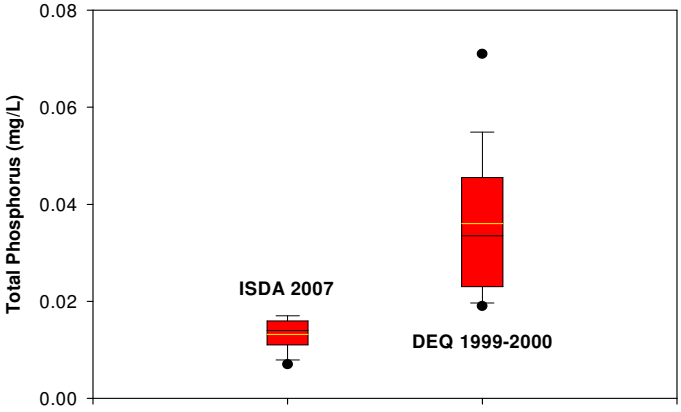

Figure 3. Box Plot TP statistical comparison for NF-1. Significant difference ($p<0.05$) in TP concentrations between 1999-2000 data compared to 2007 data. Yellow line is mean, black line is median.

Bacteria (*e-coli*)

Table 3 shows the *e-coli* detections that surpass the one time exceedance of 406 colony forming units (CFUs) for primary contact. Detections were primarily in watersheds where livestock were or had been present.

Table 3. E-coli detections (CFUs). Red numbers indicate a one time exceedance for surface water primary contact.

Date	NF-1	MC-1	LF-1	BC-1	WC-1	GF-1
5/17/2007		16	9	12	1700	3
5/31/2007	10	32	10	73	410	3
6/14/2007	37	91	96	250	980	6
6/28/2007	86	1300	64	820	1000	81
7/10/2007	110	460	50	730	290	50
8/09/2007	23	440	47	100	13	16
8/22/2007	23	81	21	88	2400	25

Dissolved Oxygen (DO)

Instantaneous dissolved oxygen measurements were taken at each site during each round of sampling. Three sites showed continuous depressed DO levels (below the state standard of 6.0 mg/L) starting near the end of June 2007 and continuing through mid-September 2007. The lowest DO levels were recorded at LF-1 (4.24 mg/L) on August 9th, BC-1 (5.01) on July 10th, and WC-1 (3.53) on August 9, 2007. NF-1 dropped below 6.0 mg/L with a reading of 5.96 mg/L on July 10th (Figure 4).

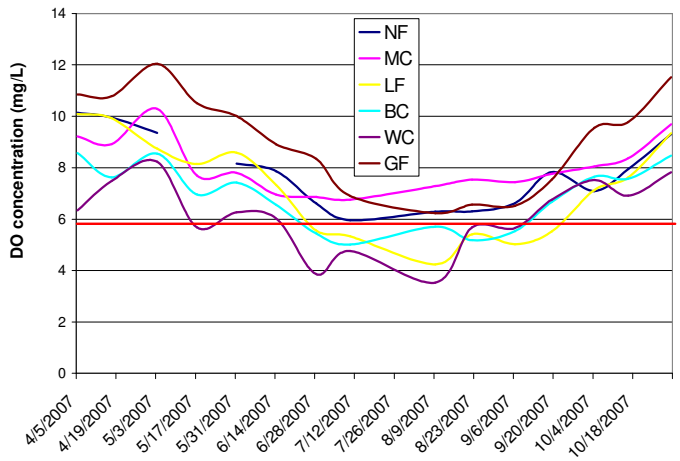

Figure 4. Instantaneous dissolved oxygen levels.

Conclusions

It is very difficult to determine the overall phosphorus reductions needed from historical data due to the limited data set. In order to get a more representative picture of what the tributaries are contributing to the reservoir, more extensive monitoring over a longer period of time would be required. It does appear from the data that at least three of the tributaries (NF-1, LF-1, and GF-1) had average phosphorus concentrations below the reservoir goal of ≤0.025 mg/L. Average phosphorus reductions were also observed at WC-1.

Overall the suspended sediment concentration for all of the tributaries were very low. One of the more pressing problems appears to be that of bedload. Erodible banks throughout these tributaries probably account for the bulk of sand that is transported. As mentioned the heavier sand tends to armor the bottom of these tributaries which makes them inhabitable for beneficial macroinvertebrates.

There appears to be a problem with dissolved oxygen levels in three of the tributaries (LF-1, BC-1, and WC-1). The lower DO levels tend to occur as water temperatures rise, flow decreases, and aquatic vegetation growth accelerates. Historical data indicates that these three station have had DO problems (DEQ 1998).

Establishing bacteria violations of state water quality standards would require geomean monitoring which requires five water quality samples within a 30 day period. It appears from the data that possibly MC-1 and WC-1 may be candidates for this type of monitoring effort.

References

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